DOCUMENT RESUME

ED 174 115 HE 011 457

AUTHOR Dumont, Richard G.; Troelstrup, Richard L.
TITLE Exploring Relationships Between Objective and Subjective Measures of Instructional Outcomes. AIR Forum 1979 Paper.
PUB DATE May 79
NOTE 29p.; Paper presented at the Annual Forum of the Association for Institutional Research (19th, San Diego, California, May 13-17, 1979)

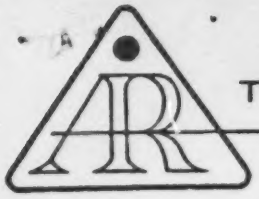
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Academic Achievement; Bibliographies; College Students; Factor Analysis; Higher Education; Institutional Research; Multiple Regression Analysis; *Predictor Variables; *Self Concept; *Student Evaluation; Test Validity
IDENTIFIERS *AIR Forum 1979; American College Testing Program; College Outcome Measures Project; *Outcomes; Tennessee Technological University

ABSTRACT

A pilot project in performance funding was conducted at Tennessee Technological University. A random sample of 112 seniors participated in a special assessment exercise involving the American College Testing (ACT) Battery and the ACT College Outcome Measures Project. The participants also completed a questionnaire designed to elicit self-reports of progress toward the realization of a set of institution-wide or general education goals. Factor analyses and item analyses were performed on self-report responses and two separate two-item indices were obtained. The relationships between the "objective," or test performance, and the "subjective," or student testimony, instructional outcomes measures were examined. The findings support the concurrent validity of the student testimony data, but the magnitude of the correlation coefficients seem to suggest that a substantial proportion of the variance in self-reported progress scores is not explained by the test performance results. The implications of the study results for the better-informed selection, implementation, and interpretation of instructional outcomes measures are discussed. Statistical data and a bibliography are included. (SW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED174115



THE ASSOCIATION FOR INSTITUTIONAL RESEARCH

This paper was presented at the Nineteenth Annual Forum of the Association for Institutional Research held at the Town and Country Inn in San Diego, California, May 13-17, 1979. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of Forum papers.

Mary Corcoran
University of Minnesota
(Editor, AIR Forum Publications)

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

AIR

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

NE 011 457

EXPLORING RELATIONSHIPS BETWEEN OBJECTIVE AND SUBJECTIVE MEASURES OF INSTRUCTIONAL OUTCOMES*

by

Richard G. Dumont, Ph.D.
Professor of Sociology and Chairman,
Department of Sociology and Philosophy
Tennessee Technological University
P.O. Box 5052
Cookeville, Tennessee 38501
Tel. (615) 528-3437

and

Richard L. Troelstrup, Ph.D.
Associate Professor of Psychology
Department of Educational Psychology
Tennessee Technological University
P.O. Box 5031
Cookeville, Tennessee 38501
Tel. (615) 528-4175

*Presented at the Nineteenth Annual Forum of the Association for Institutional Research, May 13 - 17, 1979, San Diego, California. This research was supported by a Tennessee Technological University Faculty Research Grant. Released time from instructional obligations for both authors was also arranged by the Provost and Vice President for Academic Affairs.

EXPLORING RELATIONSHIPS BETWEEN OBJECTIVE AND SUBJECTIVE MEASURES OF INSTRUCTIONAL OUTCOMES

(Abstract)

This study reports on a pilot project in performance funding. A stratified random sample of 112 seniors at Tennessee Technological University participated in a special assessment exercise involving the ACT Battery and the ACT COMP (College Outcome Measures Project). The participants also completed a questionnaire designed to elicit self-reports of progress toward the realization of a set of institution-wide or general education goals. This paper explores the relationships between "objective" or test performance and "subjective" or student testimony instructional outcomes measures. The implications for the better-informed selection, implementation, and interpretation of instructional outcomes measures are discussed.

EXPLORING RELATIONSHIPS BETWEEN OBJECTIVE AND SUBJECTIVE MEASURES OF INSTRUCTIONAL OUTCOMES

The identification and measurement of college outcomes and impacts has received increasing attention in recent years, a trend which has been an important correlate of the parallel growing demands for increasing the public accountability of higher education. Representative of some of the most widely-cited literature on accountability are the contributions by Balderston (1974), Bowen (1974; 1977), and Folger (1977); while the work of the professionals affiliated with the National Center for Higher Education Management Systems (NCHEMS) typifies and provides a focal point for national concerns with outcomes and impacts definition and assessment (e.g., Lawrence, Weathersby, and Patterson, 1970; Lenning, 1977a; Lenning, 1977b; Lenning, Lee, Micek, and Service, 1977; Lenning, Micek, and Service, 1978; Micek and Wallhaus, 1973; and Micek and Arney, 1974).

Among the major issues that have come to be of substantial interest to administrators, institutional researchers and faculty are those having to do with a wide variety of methodological problems related to measurement and to the ever-attendant issues of validity and reliability. Seminal discussions and significant insights into both general and specific methodological difficulties associated with the assessment of instructional outcomes and impacts are found in the works of Anderson, Ball, Murphy, and Associates (1973), Astin (1970a; 1970b; 1974), Baird (1977), Cooley (1976), Dressel (1972; 1976), Feldman (1970), Fincher (1978a; 1978b; 1979), Hartnett (1971), Pedazur (1975), and Rock, Centra, and Linn (1969).

Current and poignant questions having both methodological and practical implications concern the degree of convergence or strength of relationships among a variety of possible alternative approaches to measurement. As

illustrative, we may identify two of the major orientations to the assessment of instructional outcomes extant in the literature: On the one hand, student progress toward or achievement of previously articulated instructional outcomes may be assessed by use of one or more "test" instruments designed specifically to indicate the student's possession of, familiarity with, or ability to apply particular cognitive or affective traits, knowledges, or skills. On the other hand, students may alternatively be asked to provide self-reports or self-estimates of their progress or achievements in these same areas. Brown (1970), Saupe and Dressel (1972), as well as others, have labeled the first strategy the test performance approach, while the latter has been referred to as eliciting student testimony data.

Systematic investigations of the relationships between test performance and student testimony measures of instructional outcomes has both methodological and practical significance. Methodologically, important questions may be raised regarding both criterion and construct validity; while practical matters focus on making informed decisions involving the use of single or multiple indicators or the substitutability or complementarity of indicators. Both methodological and practical concerns find expression in the following question, which is becoming increasingly cogent: Since student testimony or self-report data are generally more easily and less expensively obtained than test performance data, to what extent are their respective kinds of information substitutable or complementary in the measurement of instructional outcomes?

The current investigation represents one attempt to shed some light on these timely and important matters.

DATA

Data for the present study were gathered by the senior author in the process of executing his responsibilities as Director of the THEC Performance Funding Project at Tennessee Tech University, a pilot project conducted during the academic years 1976-77 and 1977-78 (Dumont, 1977a; 1977b; 1978a; 1978b).[1] The university project was part of a larger state-wide effort sponsored by the Tennessee Higher Education Commission (THEC) and funded to a total amount in excess of one-half million dollars by grants from the Fund for the Improvement of Postsecondary Education (FIPSE), the W.K. Kellogg Foundation, the Ford Foundation, and an anonymous donor. The state-level project involved as active participants the state-wide coordinating agency (THEC), two governing boards, and eleven public, state-supported institutions, including community colleges, regional universities, a university health science center, and comprehensive, research-oriented, doctoral-granting universities.

Of the several Performance Funding Project activities, perhaps the most interesting and significant were the pilot projects conducted at the eleven selected institutions from throughout the state (Bogue and Troutt, 1977). The major objectives of each of the pilot projects were as follows:

First Year

1976-1977. The first year of these pilot projects is dedicated to the development and/or identification of instructional goals and associated performance indicators.

Second Year

1977-1978. The second year calls for the acquisition of data on these indicators and the development of ways in which performance might be incorporated into the funding project (THEC, 1976).

The goal and indicator identification and data acquisition activities of the pilot projects were focused upon institution-wide or general education instructional goals, rather than upon the instructional goals of particular courses, programs, departments, or colleges. In this regard, the position of THEC staff was that, "While this is a more 'global' level of emphasis and difficult to assess,...we believe that careful work at the institutional level may have useful spinoff benefits for assessment and internal reward at the program level" (THEC, 1976).

Fourteen institution-wide instructional goals for the pilot project at Tennessee Tech University were developed through the work of a twelve-member faculty committee, representing the University's five Colleges; and through a major survey of all University faculty, which yielded a response rate approximating 90% (Dumont, 1977a). The appropriateness of the goals received additional affirmation in subsequent major student and alumni surveys (Dumont, 1978a). Briefly, the general education goals are identifiable as "essential skills" (writing, reading, speaking, mathematical), "basic understandings" (history, social sciences, science and technology, literature), "special attributes" (critical thinking and acquaintance with major methods of inquiry), and "preparation" for "further study" and/or for "employment" (Dumont, 1978a).[2]

Three classes of indicators were identified for each instructional goal: (a) more or less "objective," readily available, and "hard" preexisting data on institutional activity, which may be justified in terms of its contributions to goal attainment; (b) extra-institutional standardized tests; and (c) student and alumni self-reports of progress toward goal attainment. The latter two classes of indicators provide the data for the present study.

The principal data-gathering efforts occurred during the months of March and April of 1978. On the morning of March 28, 1978, the ACT Battery

was administered to a stratified random sample of 112 seniors. Stratification was based upon sex, college and QPA. Students took all four subtests of the ACT Battery, English Usage, Mathematics Usage, Social Studies Reading, and Natural Sciences Reading (American College Testing Program, 1973). Precollege subtest scores on the ACT Battery were also available for each member of the sample.

Of the primary sample, 104 returned in the afternoon to take the "Communicating" and "Solving Problems" portions of the ACT COMP "Functioning Within Social Institutions" and "Using Science and Technology" sub-domains. The ACT COMP (College Outcomes Measures Project) is a test battery, still in its developmental stages, which attempts to assess the ability to use and apply skills believed to be important for a variety of adult roles outside college (Forrest, 1977; Forrest and Steele, 1977; Forrest and Steele, 1978). The COMP has been described as "...a difficult test because it measures life-long skills and concepts a graduate from college might have." It was selected as an indicator for several of the general education instructional goals for the Tennessee Tech University pilot project primarily because of the following perceived advantages: The COMP is intended to assess general education outcomes, that is, the ability to apply knowledge gained from a potentially wide variety of courses and college and university experiences. This feature is in contrast to most other assessment approaches, which generally focus more closely on the outcomes of particular programs or courses; and it made the COMP particularly desirable as providing indicators for the "institution-wide" instructional goals of the pilot project. A second attractive feature of the COMP is its use of stimulus or testing materials which are not restricted to the traditional paper and pencil tests. In particular, "real life" experiences, such as T.V. documentaries, radio broadcasts,

taped interviews, and the like are employed to elicit and/or record student responses.

For purposes of the THEC Performance Funding Project at Tennessee Tech University, students were exposed to only the "Communicating" and "Solving Problems" portions of the "Functioning Within Social Institutions" and "Using Science and Technology" substantive subdomains. Neither the "Clarifying Values" nor the "Using Art" dimensions of the COMP were relevant to the goals of the pilot project. Accordingly, the data for the present study consist of the assessed "Communicating" and "Solving Problems" abilities and skills of the senior sample in the subdomains whose definitions appear as follows:

> Functioning Within Social Institutions. Ability to identify those activities and institutions which constitute the social aspects of a culture, understand the impact that social institutions have on individuals, and analyze one's own and others' personal functioning within social institutions.
>
> Using Science and Technology. Ability to identify the scientific/technological aspects of a culture, understand the impact of such activities upon the environment, and analyze the consequences of the use of technological products for one's own self and the culture.

Within approximately one month's time subsequent to their participation in the ACT Battery and ACT COMP assessments, 93 of the original sample of 112 became respondents in a major survey of the entire senior class designed to elicit self-reported progress in the pursuit of the fourteen general education or institution-wide instructional goals identified previously. The survey questionnaires were developed using NCHEMS models for exiting students and they utilized a self-report response format having the following categories,

which were scored '1' to '5' for purposes of statistical description and analysis: (1) "No progress;" (2) "Little progress;" (3) "Moderate progress;" (4) "Much progress;" (5) "Very much progress." [3]

The analysis of the relationships between the test performance (ACT Battery and ACT COMP) and student testimony (self-reported progress) data of this study was restricted to those two major general education goal areas seen as common to the three primary indicators on the basis of face validity -- the Social and Behavioral Science Goal Area and the Science and Technology Goal Area. Descriptive statistics for the goal areas on the appropriate primary indicator categories appear in Table 1.

ANALYSIS AND RESULTS

The investigation began with an analysis of the self-report data. In particular, the interrelationships among the progress scores for the fourteen general education instructional goals were examined to determine if there existed any empirical basis for constructing indices of two or more items, indices which might contribute to enhanced reliability while simultaneously exhibiting face validity as "subjective" or student testimony counterparts of the "objective" tests' Social and Behavioral Science and Science and Technology general education goal areas. Accordingly, factor analyses and item analyses were performed on the data. Both orthogonal and oblique factor analytic rotations yielded five meaningful factors, the first two of which were clearly interpretable as Social and Behavioral Science and Science and Technology factors.[4] Subsequent item analyses of those goal statements with the highest factor loadings led to the development of two separate two-item indices. Descriptions of the two indices, together with their factor loadings (oblique solution) and inter-item zero-order correlations appear in Table 2.

Having thus determined empirically student testimony analogs to the test performance assessment categories, the relationships between these "subjective" and "objective" indicators of general education instructional outcomes were explored. The appropriate zero-order correlations are the subjects of Table 3. These data reveal low to moderate and (with one exception) statistically significant relationships between the two classes of indicators. The self-reports of progress in the Science and Technology goal area show generally closer coincidence with the comparable test performance data, especially for the ACT Battery results.

Although these findings may be interpreted as tending to support the concurrent validity of the student testimony data, the magnitude of the correlation coefficients would seem to suggest that a substantial proportion of the variance in self-reported progress scores is not explained by the test performance results. Accordingly, several other potentially relevant control or explanatory variables were identified on the bases of both prior research and an examination of their empirical relationships with the self-report indices of this study. The variables were sex, pre-college scores on the ACT Battery subtest (indicators of entering ability), major (social-behavioral science related vs. science-technology related), and course quality points (a "quantity-quality" indicator of the student's experiences at the institution with social-behavioral science and science technology courses). These four variables, together with the ACT Battery Subtest Scores and the ACT COMP subdomain scores were entered into two stepwise multiple regression analyses with hierarchical inclusion. The six predictor variables for each multiple regression analysis are given explicit definition and description below, where they appear in the order of their inclusion into the regression equation.

Predictor variables for self-reported progress in social-behavioral science general education goal areas (two-item index scores):

Sex. Dummy variable, with Male = 1 and Female = 0

N of Males = 61 ; N of Females = 32

Pre-college standard score on ACT Battery Social Studies Reading subtest.

Minimum = 5 ; Maximum = 32 ; $\bar{X}$ = 21.32 ; s = 6.69

Major. Dummy variable that student's major prompts self-reports of higher degrees of progress in the social - behavioral sciences.

1 = Business Administration; Humanities; Social or Behavioral Science. N = 29

0 = Agriculture; Home Economics; Natural Sciences; Math or Computer Science; Engineering; Education. N = 64

Quality points in social and behavioral sciences course. The sum of the cross-products of quarter hours by grade earned, where A=4, B=3, C=2, D=1, and F=0.

Minimum = 12 ; Maximum = 357 ; $\bar{X}$ = 96.62 ; s = 80.95

"Achievement test" score. Raw score earned on the March 28, 1978 administration of the ACT Battery Social Studies Reading Subtest.

Minimum = 13 ; Maximum = 49 ; $\bar{X}$ = 34.83 ; s = 8.69

"Applications test" score. Sum of the "Communicating" and "Solving Problems" portions of the "Functioning Within Social Institutions" subdomain of the ACT COMP, administered on March 28, 1978.

Minimum = 7 ; Maximum = 39 ; $\bar{X}$ = 24.25 ; s = 7.70

Predictor variables for self-reported progress in science - technology general education goal area (two-item index scores):

Sex. Dummy variable, with Male = 1 and Female = 0

N of Males = 61 ; N of Females = 32

Pre-college standard score on ACT Battery Natural Sciences Reading Subtest.

Minimum = 9 ; Maximum = 34 ; $\bar{X}$ = 24.26 ; s = 5.98

Major. Dummy variable that student's major prompts self-reports of higher degrees of progress in science - technology.

1 = Agriculture; Natural Sciences; Engineering. N = 42

0 = Home Economics; Business Administration; Humanities; Social Sciences; Math or Computer Science; Education. N = 51

Quality points in natural sciences courses. The sum of the cross-products of quarter hours by grade earned, where A=4, B=3, C=2, D=1, and F=0.

Minimum = 16 ; Maximum = 452 ; $\bar{X}$ = 76.82 ; s = 72.08

"Achievement test" score. Raw score earned on the March 28, 1978 administration of the ACT Battery Natural Sciences Reading Subtest.

Minimum = 13 ; Maximum = 50 ; $\bar{X}$ = 33.77 ; s = 8.35

"Applications test" score. Sum of the "Communicating" and "Solving Problems" portions of the "Using Science and Technology" sub-domain of the ACT COMP, administered on March 28, 1978.

Minimum = 6 ; Maximum = 43 ; $\bar{X}$ = 25.04 ; s = 6.85

The pertinent results of the two regression analyses are summarized in Tables 4 and 5, for the Social - Behavioral Science and Science-Technology goal areas, respectively.[5] The data reveal that, in addition to being related to Test Performance on both an "Achievement Test" (ACT Battery Subtests) and an "Applications Test" (ACT COMP), students' self-reports of progress made toward selected general education instructional goals also show moderate to high and statistically significant correlations with student Background Factors (Sex and Pre-college ACT Battery Subtest standard scores) and Institutional Experience Factors (Major and Quality points in goal-relevant courses). The findings also reveal that when the three classes of variables are entered into a multiple regression analysis in approximate "chronological" or "logical" order most of the explained variance in self-reports or student testimony is a function of Background and Institutional Experience Factors. These results are true of both the Social - Behavioral Science and the Science - Technology general education instructional goal areas of this study, especially the latter.

DISCUSSION

The findings emerging from our analyses are generally consistent with the published results of those studies which have provided evidence in support of the validity of self-reports, and which have been cited in a fairly extensive literature review by Lenning (1977c). Some of the more recent of those studies include the works of Baird (1976), Berdie (1971), Frey and Beatty (1975), Hoyt (1973), Hoyt, Owens and Grouling (1973), McMorris and Ambrosino (1973), and Pohlmann and Beggs (1974). Although these related works show correlations which are considerably higher than those reported here, it should be noted that the characteristic focus of such validation inquiries has been upon the correspondence between self-

reports and fairly precise task or course performance objective data. For example, Berdie (1971) reported correlations of .47 to .74 between "self-claimed" and "tested knowledge" of a specific list of famous people, while Pohlmann and Beggs (1974) showed statistically significant correlations of .52 to .67 for their course-experienced-based study. One would expect the correspondence between student testimony and test performance data for broader and somewhat more nebulous general education outcomes pursued for approximately four years of undergraduate study to be notably less than that for much more precisely formulated and immediately experienced course events and outcomes.

Our results also suggest that, with regard to the assessment of general education instructional outcomes in particular, a notable proportion of the variance in self-report ratings is explained by Background Factors and Institutional Experience Factors and less by the student's ability to perform on extra-institutional standardized tests of either the "achievement" or "applications" varieties. The implications are that self-report data for general education instructional goals have more validity as indicators of student Background and Institutional Experience Factors, while they are less appropriate as indicators of actual ability to perform on extra-institutional standardized tests. With regard to the selection and use of indicators for the assessment of general education instructional outcomes, the implications seem reasonably clear: That is, student testimony or self-report data should be viewed as complementary to test performance data. Their non-substitutability strongly recommends the efficacy and desirability of a multiple-indicator assessment strategy.

In conclusion, it is fitting that we both recognize and emphasize that our findings and interpretations must be qualified in terms of the limitations imposed by our sample and our measurement instruments. Further,

comparative research utilizing a variety of institutions as well as alternative test performance and student testimony outcomes indicators are recommended. Ideally, gain scores (requiring premeasurement on the objective tests) and control samples ought also to be incorporated in further studies in the interest of more definitive findings and more confident generalizations.

Table 1: Descriptive Statistics for THEC Performance Funding Project Outcomes Measures -- ACT Battery Subtests (Raw Scores), ACT COMP Subdomain Scores, and Self-Reported Progress Responses to Selected General Education Instructional Goals (N=93).

Outcomes Measures or Indicators	Maxima and Minima Of Possible Scores	Of Sample Scores	Sample Mean	Sample S.D.
ACT BATTERY SUBTESTS:				
Social Studies Reading	0 - 52	13 - 49	34.83	8.69
Natural Sciences Reading	0 - 52	13 - 50	33.77	8.35
ACT COMP:				
Functioning Within Social Institutions	0 - 56	7 - 39	24.25	7.70
Using Science and Technology	0 - 56	6 - 43	25.04	6.85
SELF-REPORTED PROGRESS IN DEVELOPING:				
Mathematical Ability	1 - 5	1 - 5	3.36	1.26
Democracy and Citizenship	1 - 5	1 - 5	2.96	1.00
History and Geography	1 - 5	1 - 5	3.28	.96
Science and Technology	1 - 5	1 - 5	3.60	1.06
Economics	1 - 5	1 - 5	2.84	1.23
Behavioral Sciences	1 - 5	1 - 5	3.42	1.02
Critical Thinking	1 - 5	2 - 5	3.74	.86
Familiarity with Major Methods of Inquiry	1 - 5	2 - 5	3.15	.90

Table 2: Factor Loadings (Oblique Solution) and Zero-Order Correlations for Self-Report Responses on Social and Behavioral Science and Science and Technology General Education Goal Areas Two-Item Indices (N=93).

Factors (Indices) and Associated Items	Factor Loadings	Inter-Item Correlations
SOCIAL AND BEHAVIORAL SCIENCE FACTOR (INDEX):		
History and Geography	.70	.44
Behavioral Sciences	.74	
SCIENCE AND TECHNOLOGY FACTOR (INDEX):		
Mathematical Ability	.65	.54
Science and Technology	.85	

Table 3: Zero-Order Correlations Between Student Testimony and Test Performance Indicators of Social and Behavioral Science and Science and Technology General Education Instructional Goal Areas (N=93).

Test Performance Indicators	Student Testimony (Self-Reported Progress) Indicators: Social and Behavioral Science Goal Area	Science and Technology Goal Area
ACT BATTERY SUBTESTS:		
Social Studies Reading	.14	
Natural Sciences Reading		.34***
ACT COMP:		
Functioning Within Social Institutions	.21*	
Using Science and Technology		.24**

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 4: Summary of Pertinent Results of Multiple Regression Analysis Utilizing the Self-Reported Progress in Social and Behavioral Science Index as the Dependent Variable (N=93).

Predictor Variables	Simple R	Multiple R	R^2	R^2 Change	F Ratio for R^2 Change
BACKGROUND FACTORS:					
Sex	-.26499**	.26499	.07022	.07022	8.08**
Pre-college Standard Score on Social Studies Reading Subtest of ACT	.05017	.26603	.07077	.00055	.06
INSTITUTIONAL EXPERIENCE FACTORS:					
Major	.32846***	.40363	.16292	.09214	10.60**
Quality Points in Social and Behavioral Science Courses	.42820***	.46608	.21723	.05431	6.25*
TEST PERFORMANCE INDICATORS:					
ACT Social Studies Reading Subtest Raw Score on March 28, 1978	.13890	.50224	.25224	.03502	4.03*
ACT COMP Functioning Within Social Institutions Subdomain Score	.20679*	.50272	.25273	.00049	.06

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 5: Summary of Pertinent Results of Multiple Regression Analysis Utilizing the Self-Reported Progress in Science and Technology Index as the Dependent Variable (N=93).

Predictor Variables	Simple R	Multiple R	R^2	R^2 Change	F_{R^2} Ratio for R^2 Change
BACKGROUND FACTORS:					
Sex	.21750*	.21750	.04731	.04731	7.55**
Pre-college Standard Score on Natural Sciences Reading Subtest of ACT	.30537***	.36510	.13329	.08599	13.71***
INSTITUTIONAL EXPERIENCE FACTORS:					
Major	.66453***	.66940	.44809	.31480	50.21***
Quality Points in Natural Sciences Courses	.29685**	.67115	.45045	.00235	.37
TEST PERFORMANCE INDICATORS:					
ACT Natural Sciences Reading Subtest Raw Score on March 28, 1978	.34381***	.67175	.45124	.00079	.13
ACT COMP Using Science and Technology Subdomain Score	.23759**	.67857	.46046	.00921	1.47

* $p < .05$, ** $p < .01$, *** $p < .001$

FOOTNOTES

1. Tennessee Tech University is a regional institution of approximately 6,500 FTE students, founded in 1915 and located in Cookeville, a city of 20,000. Tennessee Tech, which is part of the State University and Community College System of Tennessee, offers a range of undergraduate and graduate programs in five colleges. A single interdisciplinary doctoral degree in engineering is offered.
2. A detailed list of the instructional goals together with the survey questionnaires may be obtained by writing the senior author.
3. A copy of the survey questionnaire is available upon request to the senior author.
4. Copies of factor pattern and factor structure matrices for both orthogonal and oblique rotations are available upon request to the senior author.
5. More detailed results of the regression analyses, including partials and beta coefficients, are available upon request to the senior author.

REFERENCES

American College Testing Program. Assessing students on the way to college: Technical report for the ACT assessment program. Iowa City, Iowa: ACT, 1973.

Anderson, Scarvia, Samuel Ball, Richard T. Murphy and Associates. Encyclopedia of educational evaluation. San Francisco: Jossey-Bass, 1973.

Astin, Alexander W. The methodology of research on college impact, part one. Sociology of Education, 1970a,43, 223-254.

Astin, Alexander W. The methodology of research on college impact, part two. Sociology of Education, 1970b,43, 437-450.

Astin, Alexander W. Measuring the outcomes of higher education. In Howard R. Bowen (ed.), Evaluating institutions for accountability: New directions for institutional research (number 1). San Francisco: Jossey-Bass, 1974, pp. 23-46.

Baird, Leonard L. Using self-reports to predict student performance. New York: College Entrance Examination Board, 1976.

Baird, Leonard L. Assessing student academic and social progress: New directions for community colleges (number 18). San Francisco: Jossey-Bass, 1977.

Balderston, Frederick E. Managing todays university. San Francisco: Jossey-Bass , 1974.

Berdie, R.F. Self-claimed and tested knowledge. Educational and Psychological Measurement, 1971, 31, 629-636.

Bogue, E. Grady and William E. Troutt. Allocation of state funds on a performance criterion, the Performance Funding Project: A status report. Nashville, Tennessee: Tennessee Higher Education Commission, 1977.

Bowen, Howard R. (ed.). Evaluating institutions for accountability: New directions for institutional research (number 1). San Francisco: Jossey-Bass, 1974.

Bowen, Howard R.. Investment in learning. San Francisco: Jossey-Bass, 1977.

Brown, David G.. A scheme for measuring the output of higher education. In Ben Lawrence, George Weathersby, and Virginia W. Patterson (eds.), The outputs of higher education: Their identification, measurement, and evaluation. Boulder, Colorado: Western Interstate Commission for Higher Education, 1970.

Cooley, W.W., and P.R. Lohnes. Evaluation research in education. New York: Irvington Publishers, 1976.

Dressell, Paul L.. Institutional research in the university: A handbook. San Francisco: Jossey-Bass, 1972.

Dressell, Paul L.. Handbook of academic evaluation. San Francisco: Jossey-Bass, 1976.

Dumont, Richard G.. Instructional goals survey: THEC Performance Funding Project. Cookeville, Tennessee: THEC Performance Funding Project, 1977a.

Dumont, Richard G.. End-of-year report for the THEC Performance Funding Project at Tennessee Technological University. Cookeville, Tennessee: THEC Performance Funding Project, 1977b.

Dumont, Richard G.. Final report for the THEC Performance Funding Project at Tennessee Technological University. Cookeville, Tennessee: THEC Performance Funding Project, 1978a.

Dumont, Richard G.. Report on a pilot project in performance funding. Houston, Texas: Paper presented at the Eighteenth Annual Forum of the Association for Institutional Research, May 21-25, 1978b.

Feldman, Kenneth A. Research strategies in studying college impact. Iowa City, Iowa: The American College Testing Program, Research Report No. 34, May, 1970.

Fincher, Cameron. Importance of criteria for institutional goals. New Directions for Institutional Research (number 19). San Francisco: Jossey-Bass, 1978a.

Fincher, Cameron. Program monitoring in higher education. New Directions for Program Evaluation (number 3). San Francisco: Jossey-Bass, 1978b.

Fincher, Cameron. Economic and sociological studies of educational effects. The Educational Forum, 1979, January, 139-151.

Folger, John K. (ed.). Increasing the public accountability of education. New directions for institutional research (number 16). San Francisco: Jossey-Bass, 1977.

Forrest, Aubrey. Competency-based assessment in postsecondary education - some issues and answers. North Central Association Quarterly, 1977, 52, 322-326.

Forrest, Aubrey and Joe Steele. COMP: College outcomes measures project. Annual report. Iowa City, Iowa: The American College Testing Program, 1977.

Forrest, Aubrey and Joe Steele. COMP Annual report 1978: College outcomes measures project. Iowa City, Iowa: The American College Testing Program, 1978.

Frey, P.W., D.W. Leonard, and W.W. Beatty. Student ratings of instruction: Validation research. American Educational Research Journal, 1975, 12, 435-447.

Hartnett, R.T. Accountability in higher education: A consideration of some of the problems of assessing college impacts. New York: College Entrance Examination Board, 1971.

Hoyt, D.P. The Kansas State University program for assessing and improving instructional effectiveness. In A.L. Sockloff (ed.), Proceedings: Faculty effectiveness as evaluated by students. Philadelphia: Measurement and Research Center, Temple University, 1973.

Hoyt, D.P., R.E. Owens, and T. Grouling. Interpreting 'Student feedback on instruction and courses': A manual for using student feedback to improve instruction. Mahattan, Kansas: Office of Educational Resources, Kansas State University, 1973.

Lawrence, Ben, George Weathersby, and Virginia W. Patterson (eds.). Outputs of higher education: Their identification, measurement, and evaluation. Boulder, Colorado: Western Interstate Commission for Higher Education, July, 1970.

Lenning, Oscar T. The outcomes structure: An overview and procedures for applying it in postsecondary education institutions. Boulder, Colorado: National Center for Higher Education Management Systems, 1977a.

Lenning, Oscar T. Previous attempts to 'structure' educational outcomes and outcome-related concepts: A compilation and review of the literature. Boulder, Colorado: National Center for Higher Education Management Systems, 1977b.

Lenning, Oscar T. Assessing student progress in academic achievement. In Leonard L. Baird (ed.), Assessing student and academic progress: New Directions for Community Colleges (number 18). San Francisco: Jossey-Bass, 1977c, pp. 1-20.

Lenning, Oscar T., Y.S. Lee, S.S. Micek, and A.L. Service. A structure for the outcomes of postsecondary education. Boulder, Colorado: National Center for Higher Education Management Systems, 1977.

Lenning, Oscar T., Sidney S. Micek, and Allan L. Service. A conceptual framework for educational outcomes. Toronto, Ontario, Canada: Paper presented at the 1978 Annual Meeting of the American Educational Research Association, March, 1978.

McMorris, R.F. and R.J. Ambrosino. Self-report predictors: A reminder. Journal of Educational Measurement, 1973, 10, 13-17.

Micek, Sidney S. and Robert A. Wallhaus. An introduction to the identification and uses of higher education outcome information, Technical report 40. Boulder, Colorado: National Center for Higher Education Management Systems and Western Interstate Commission for Higher Education, 1973.

Micek, S.S., and W.R. Arney. The higher education outcome measures identification study: A descriptive summary. Boulder, Colorado: National Center for Higher Education Management Systems, 1974.

Palola, E.G. and T. Lehmann. Student outcomes and institutional decision making with PERC. In O.T. Lenning (ed.), Improving educational outcomes: New directions for higher education (number 16). San Francisco: Jossey-Bass, 1976.

Pedazur, E.J. Analytic methods in studies of educational effects. In F.N. Kerlinger (ed.), Review of research in education, Volume 3. Itasco, Illinois: F.E. Peacock Publishers, 1975.

Pohlmann, J.T. and D.L. Beggs. A study of validity of self-reported measures of academic growth. Journal of Educational Measurement, 1974, 11, 115-119.

Rock, D.A, J.A. Centra, and R.L. Linn. The indentification and evaluation of college effects on student achievement. Princeton, New Jersey: Educational Testing Service, 1969.

Saupe, Joe L. and Paul L. Dressel. Evaluating outcomes of instruction. In Paul L. Dressel, Institutional research in the university: A handbook. San Francisco: Jossey-Bass, 1972.

Tennessee Higher Education Commission. Performance Funding Project 1976-1978. A project brochure. Nashville, Tennessee: Tennessee Higher Education Commission, 1976.